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CHEMICAL EXPLOSION PRODUCED IN THE HIGH ATMOSPHERE

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A CHEMICAL EXPLOSION PRODUCED IN THE HIGH ATMOSPHERE

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On 18 June 1960 we used a Veronica rocket, fired at Hammaguir (Algeria) at 2005 hours (angle of solar dip, $\Theta = 11$) to produce an explosion of 65 kg of exogene tollite at an altitude of 157 km. The purpose of the experiment is the study of shock waves in the high atmosphere. A sodium cloud is emitted from the rocket during the ascent from an altitude of 143 km in sight of the observation of events during the second which follows the explosion. From the data collected in the field which will be the object of future publication, we are singling out the following results:

1. Optical observations. A luminous phenomenon of white color and radiate structure, caused by the shock wave, is visible for 1 to 2 seconds covering a surface of some dozens of degrees. Then one observes a green ball with a diameter of about 4° surrounded by a red ring whose width is $0^{\circ},5'$. The red ring disappears in three minutes and the green ball in 13.5 minutes.

Four spectra have been obtained (see table) with a Cojan f/0.7 spectrograph. The interpretation of visible phenomena with this is:

1. The red ring is due to the thermal excitation of the doublet 6300-6363 of O [I] by the shock wave. The time of disappearance corresponds to the duration of life of the level (110 sec).

2. The sodium present in the rocket was observed in all the spectra. The polarization of its resonance line was measured and found to be rather high (4%) which

suggests that the optical density of the cloud was too weak to permit a measurement of the temperature.

3. The green ball is caused by the optical resonance of AlO coming from debris from the rocket. The line 5,577 A of O [I] was not positively observed. The phenomenon vanishes when there is no more light from the sun.

4. An unidentified component appeared in the ultraviolet; it was also detected by an eight color photometer of the type Barbier.

The shape of the ball was measured by triangulation. It developed very rapidly:

The explosion took place after the culmination of the rocket, 500 m below the apogee. The ball, however, ascended during the three minutes when measurements were possible to 161 km with a speed of 22 m/sec. After several seconds when it presented an irregular appearance, it assumed a spherical shape which expanded regularly for two minutes after which the speed of expansion became different in the three dimensions: 37.5 m/sec expansion in the direction East-West; 90 m/sec in the vertical direction; in the direction North-South, however, the ball seemed to flatten for several minutes with a speed on the order of 40 m/sec; it assumed a shape elongated in the direction East-West.

Spectrum of the Luminous Phenomenon.

(A)	Identity	Relative Intensity	Observations
6400	O [I]	2.5	Visible in 2nd spectrum only (exposure time: 2 minutes)
5893	Na	10 (saturated)	Visible on all spectra
5370-5400	AlO($A^2\Sigma^+ \rightarrow X^2\Sigma^+$)	5	" "
5079-5123	"	10	" "
4842-4860	"	10	" "
4648-4670	"	10	" "
4470-4490	"	3	" "
4200-4250	?	1.5	Visible in 2nd spectrum only
3600-3800	?	1	Visible in first spectrum only (exposure time: 30 sec)

2. Accoustic observations. Three microbarographs were placed at Hammaguir, Beni-Abbes and Adrar. Only the equipment at Hammaguir recorded a signal with total amplitude 0.2 barye for the very low frequency microbarograph (0.15 c/sec) and 0.1 barye for the low frequency microbarograph (0.5 c/sec). The time of activity of the signal corresponded to several pitches; the pitch of the apparatus itself was 3 c/sec. This signal, with a total duration of 8 seconds, arrived 8 minutes and 40 seconds after the explosion which took place at a straight line distance of 193 km from the barographs. Propagation during the first 20 km is so poorly known that it is not possible to calculate the mean speed of propagation of the sound and the actual trajectory of the sound energy received.

3. Magnetic observations. Two identical stations were located at Hammaguir and at Beni-Abbes (distance about 100 km). They included: a recording device of the type "bar flux-meter" with three components capable of detecting any magnetic impulse greater than 1/200^{e} of a gamma; recording of telluric current on two perpendicular lines of 100 m (absolute sensitivity boundary approximately 20 μV/km).

The recordings cover a period of two weeks of continuous operation. At the time of the explosion, the natural magnetic conditions were favorable showing only groups of discontinuous oscillations with a period of about 2 seconds and an amplitude less than $10^{-2}\gamma$ clearly determinable. These groups were identifiable wave for wave in synchronization at the two stations. No signal attributable to the explosion could be raised. We assign an upper limit of about 1/200^{e} of a gamma to any possible magnetic effect of the explosion.

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